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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/634,764	08/07/2000	Ingrid B. Carlbom	2925-451P	3428

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EXAMINER	
PHAN, THAI Q	
ART UNIT	**PAPER NUMBER**
2128	

DATE MAILED: 03/13/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)
	09/634,764	CARLBOM ET AL.
	Examiner	Art Unit
	Thai Q. Phan	2128

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *26 April 2005*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-34* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-34* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *27 February 2001* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☐ Other: _____.

DETAILED ACTION

This Office Action is in response to applicants' amendment filed on 04/26/2005.

Claims 1-34 are pending in the Action.

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 1-4, 6-1 1, 18-2 1, and 23-28 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nagamitsu et al, US patent no. 5,467,401.

As per claim 1, Nagamitsu discloses a sound eave simulator for measure of real sound wave effects in a three-dimensional environment with feature limitations very similar to the claimed invention (Abstract and Summary of the Invention). According to Nagamitsu, the method of modeling the sound wave propagation in the spatial 3-dimensional environment includes steps:

computing wave propagation paths from sources to other regions in the space model or the spatial environment (col. 5, lines 1-22, col. 6, line 16 to col. 7, line 45, for example),

generating at least reverberation or echo path between the source and a receiver

based on at least one computed wave propagation path and path convolution as claimed (Figs. 9, 10, col. 8, line 49 to col. 9, line 10, for example). Nagamitsu discloses impulse responses for each incident location, incident directions from sound waves reflection in various directions, specific reflect beam rays in a sequence order (col. 6, lines 16-27), and sound bands (col. 8, line 66 to col. 9, line 10, for example) and ordering of sound waves (col. 10, lines 47-52) based on weight corresponding to the arrival time for sound ray tracing for wave reflections directly or indirectly, wherein the arrival time is computed from traveling distance from source to destination (col. 7, lines 5-17, col. 8, lines 39-41), which is similar to travel path priority as defined in the present specification because the arrival time is dependent on travel path or distance, and it is weighted based on travel time priority. Nagamitsu requires convolving the impulse response and listener desire positions on the sound source data to generate the reproduced data (col. 8, lines 49-65, col. 9, lines 29-35). Since convolution is a linear operator having associative property, it can convolve impulse response components selected in a desire environment and specified reflect beam rays in a priority as specified above or in a priority order as claimed to reproduce a sound wave in a specific location in real time as claimed. Nagamitsu does not expressly disclose a priority order of computing wave propagation as claimed.

Practitioner in the art at the time of the invention was made would have found Nagamitsu disclosure of ordering of reflection of incident waves, directly from sound sources or indirectly from reflection waves, by assigning weight to arrival time or timestamp of wave arrivals with taking travel path into consideration in order to time

stamp or weighted arrival time for incident waves (see col. 7, lines 5-17), and computing wave responses for incident waves for each direction selected, a desire spatial space, a selected reflect beam (array) by convolving the impulse response and listener desire positions on the sound source data to generate the reproduced data (col. 8, lines 49-65, col. 9, lines 29-35) would include the claimed limitation of priority order of computing wave propagation in order to reflect sound waves incident directly form sound sources or indirectly from reflection such that memory capacity would be increased, and faster simulator in real environment and in real time would be obtained as disclosed in col. 10, lines 2-11, lines 30-35, lines 43-45, for example.

As per claim 2, Nagamitsu discloses a method of modeling acoustic wave propagation in 3-D environment (Figs. 1-6).

As per claim 3, Nagamitsu discloses a memory (18), for example, for storing indexed sections of sound source patterns which would obviously imply a data structure being used for storing sections of sound sources and its propagation path information for efficient storage and computation (Figs. 5, 6, cols. 5-8).

As per claim 4, Nagamitsu discloses tracing propagation paths through the spatial environment step of representing sound environment surface as cell adjacent graph and traversing such graph in order to simulate sound in the environment (col. 5, lines 60-63, for example).

As per claims 6-7, Nagamitsu discloses sound source and sound receiver are moving (cols. 10-11).

As per claim 8, Nagamitsu discloses impulse response and convolving the impulse response with a source signal to generate a spatial output signal as claimed (Figs. 5-10, cols. 7-9).

As per claim 9, Nagamitsu discloses encoded data in spatial environment (Figs. 5-6, for example).

As per claim 10, Nagamitsu models acoustic reverberation paths between avatar locations such as in concert hall, for example (Background of the Invention).

As per claim 11, Nagamitsu discloses sound source data and propagation paths are encoded for structure sections and stored in memory (Figs. 5, 6, col. 5, lines 25-55), such structure sections with encoded information stored in memory are called data structure as obviously known for those skilled in the computer computation art for effectively simulating acoustic sound effects in spatial environment using the ray tracing techniques (col. 5, line 60 to col. 6, line 2, for example). Nagamitsu also discloses assigning weight corresponding to the arrival time, including early arrival time, for each sound ray in ray tracing (col. 8, lines 39-41).

As per claim 18, Nagamitsu discloses a sound environment simulator for measure of sound wave effects with feature limitations very similar to the claimed invention (Abstract and Summary of the Invention). According to Nagamitsu, the apparatus of modeling sound wave propagation in the spatial 3-dimensional environment includes means for computing wave propagation paths from sources to other regions in the spatial environment (col. 5, lines 1-22, col. 6, line 16 to col. 7, line 45, for example),

generating at least reverberation or echo path between the source and a receiver based on at least one computed wave propagation path and path convolution as claimed (Figs. 9, 10, col. 8, line 49 to col. 9, line 10, for example). Nagamitsu discloses impulse responses for each incident location, incident directions from sound waves reflection in various directions, specific reflect beam rays in a sequence order (col. 6, lines 16-27), and sound bands (col. 8, line 66 to col. 9, line 10, for example) and ordering of sound waves (col. 10, lines 47-52) based on weight corresponding to the arrival time for sound ray tracing for wave reflections directly or indirectly, wherein the arrival time is computed from traveling distance from source to destination (col. 7, lines 5-17, col. 8, lines 39-41), which is similar to travel path priority as defined in the present specification because the arrival time is dependent on travel path or distance between paths, and it is weighted based on travel time priority. Nagamitsu requires convolving the impulse response and listener desire positions on the sound source data to generate the reproduced data (col. 8, lines 49-65, col. 9, lines 29-35). Since convolution is a linear operator having associative property, it can convolve impulse response components selected in a desire environment, in specified reflect beam rays, arrival time of the beam array in a specified order as above or in priority manner as claimed to reproduce a sound wave in a specific location in real time as claimed. Nagamitsu does not expressly disclose a priority order of computing wave propagation as claimed.

Practitioner in the art at the time of the invention was made would have found Nagamitsu disclosure of ordering of reflection of incident waves, directly from sound

sources or indirectly from reflection waves, by assigning weight to arrival time or timestamp of sound wave would be arrival with taking travel path into consideration in order to time stamp or weighted arrival time for incident waves (see col. 7, lines 5-17), and computing wave responses for all incident waves for each direction by convolving the impulse response and listener desire positions on the sound source data to generate the reproduced data (col. 8, lines 49-65, col. 9, lines 29-35) would include the claimed limitation of priority order of computing wave propagation in order to reflect sound waves incident directly form sound sources or indirectly from reflection such that memory capacity would be increased, and faster simulator in real environment and in real time would be obtained as disclosed in col. 10, lines 2-11, lines 30-35, lines 43-45, for example.

As per claim 19, Nagamitsu discloses the apparatus for modeling acoustic wave propagation or sound reverberation in 3-D environment (Figs. 1-6).

As per claim 20, Nagamitsu discloses memory (18) for storing indexed sections of sound source patterns which would obviously imply a data structure being used for storing sections of sound sources and its propagation path information for efficient storage and computation (Figs. 5, 6, cols. 5-8).

As per claim 21, Nagamitsu discloses step of tracing propagation paths through the spatial environment step of representing sound environment surface as cell adjacent graph and traversing such graph in order to simulate sound in the environment (col. 5, lines 60-63, for example).

As per claims 23 and 24, Nagamitsu discloses sound source and sound receiver are moving (cols. 10-11).

As per claim 25, Nagamitsu discloses means for performing impulse response and convolving the impulse response with a source signal to generate a spatialized output signal as claimed (Figs. 5-10, cols. 7-9).

As per claim 26, Nagamitsu discloses reverberation paths between source and receivers are encoded and stored in computer memory. Such memory could include a data structure for storing encoded data structure in an efficient manner for ray tracing techniques (Figs. 5-6, col. 5, lines 60-64, for example).

As per claim 27, Nagamitsu models acoustic reverberation paths between avatar locations such as in concert hall for multiuser environment, for example (Background of the Invention).

As per claim 28, Nagamitsu discloses sound source data and propagation paths are encoded for structure sections and stored in memory (Figs. 5, 6, col. 5, lines 25-55), such structure sections with encoded data are stored in memory are called data structure as obviously known in the computer computation art for effectively simulating acoustic sound effects in spatial environment. Nagamitsu also discloses assigning weight corresponding to the arrival time for each sound ray in ray tracing (col. 8, lines 39-41) based on travel distance from source to destination (col. 7, lines 5- 17).

3. Claims 5, and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nagamitsu et al. US patent no. 5,467,401 as applied to claims 1, and 18, respectively above, and further in view of Reed et al., US patent no. 5,574,466.

As per claim 5, Nagamitsu discloses sound simulation method for virtually simulating sound effect in space model or spatial environment (see claim 1 rejection above). Nagamitsu requires convolving the impulse response and listener desire positions on the sound source data to generate the reproduced data (col. 8, lines 49-65, col. 9, lines 29-35). Since convolution is a linear operator having associative property, it can convolve impulse response components in a priority order for a specific reflected beam array, a selected spatial space, etc. to reproduce a sound wave in a specific location in real time as claimed.

Nagamitsu discloses beam array and array reflection but does not expressly disclose beamtree with tree node and node priority value as claimed. Such features are well-known in the art of signal processing. In fact, Reed teaches data structure as tree being used in ray tracing (Figs. 2, 14, col. 3, line 50 to col. 4, line 9, col. 5, lines 8-63, col. 7, lines 1-15, for example), with tree nodes, nodal arrival time or priority, etc. as claimed, to improve memory storage and computation speed in ray tracing techniques.

This would motivate practitioner in the related art at the time of the invention was made to combine Reed teaching of tree data structure to store model data into ray tracing techniques as disclosed in Nagamitsu to modify Nagamitsu disclosure in order to improve computation and memory storage as taught in Reed in the Background of the Invention.

As per claim 22, Nagamitsu discloses sound simulation method for virtually simulating sound effect in spatial environment (see claim 18 rejection above). Nagamitsu does not expressly disclose beam-tree with tree node, cell boundary, and node cell priority value as claimed. Such features are well-known in the art. In fact, Reed teaches data structure for modeling wave propagation in spatial environment as beam tree for ray tracing (Figs. 2, 14, col. 3, line 50 to col. 4, line 9, col. 5, lines 8-63, col. 7, lines 1- 15, for example), with beam tree characteristics such as tree node locations, nodal arrival time for priority, cell boundary for environment corners, etc. as claimed, to improve memory storage and computation speed in ray tracing techniques.

This would motivate practitioner in the related art at the time of the invention was made to combine Reed teaching of tree data structure to store model data into ray tracing techniques as disclosed in Nagamitsu to improve computation and memory storage as taught in Reed in the Background of the Invention.

4. Claims 12- 17, and 29-34 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nagamitsu, Patent no. 5,467,401, in view of Reed et al., US patent no. 5,574,466.

As per claim 12, Nagamitsu discloses a method of modeling coherent wave propagation in a spatial environment with feature limitations substantially similar to the claimed invention (Abstract and Summary of the Invention). According to Nagamitsu, the modeling method includes steps of constructing sound source data by processing sound source by convolving the impulse response and listener desire positions on the

sound source data to generate the reproduced data (col. 8, lines 49-65, col. 9, lines 29-35). Since convolution is a linear operator having associative property, it can convolve impulse response components in a priority order or in a bidirectional manner to reproduce a sound wave in a specific location in real time as claimed

and tracing beam bidirectionally because ray tracing techniques trace or detect directive sounds directly incident on receiver from various sound sources (col. 5, line 59 to col. 6, line 12) between a plurality of sound sources, including a pair of sound sources, in the spatial environment (col. 7, line 63 to col. 8, line 7, for example), and computing a filter response for at least one path between the pairs (cols. 7-8). Nagamitsu does not expressly disclose a specific data structure like tree as claimed.

Such feature is well-known in the art. In fact, Reed teaches method and system for encoding wave propagation data in tree structure for used in ray tracing (Figs. 2, 14, col. 5, lines 8-63, for example) to improve memory storage and computation speed in ray tracing techniques.

This would motivate practitioner in the related art at the time of the invention was made to combine Reed teaching of tree data structure to store model data into ray tracing techniques as disclosed in Nagamitsu to improve computation and memory storage as taught in Reed in the Background of the Invention.

As per claim 13, Nagamitsu discloses sound a source simulation between an audio source and a receiver location (Summary of the Invention).

As per claim 14, Reed teaches tree structure for storing traced ray (Figs. 2 and 14), and such beamtree could be encoded for reverberation paths as disclosed in Nagamitsu.

As per claim 15, Reed teaches tracing adjacent cells or nodes in the structure beam tree in a spatial environment.

As per claim 16, Nagamitsu discloses computing reverberation source paths between the plurality of sources (cols. 5 and 6), and Reed teaches tracing beam tree in ray tracing techniques (Fig. 2, 14, col. 5, lines 8-63, col. 7, lines 15-65, for example).

As per claim 17, Nagamitsu discloses such limitations in virtual sound simulation in spatial regions as claimed.

As per claim 29, Nagamitsu discloses apparatus for modeling coherent wave propagation in a spatial environment with feature limitations substantially similar to the claimed invention (Abstract and Summary of the Invention). According to Nagamitsu, the modeling apparatus includes means for

constructing sound source data by tracing beam bidirectionally because ray tracing techniques trace directive sound waves directly incident on user receiver from various sound sources (col. 5, line 59 to col. 6, line 12) between a plurality of sound sources, including a pair of sound sources, in the spatial environment (col. 7, line 63 to col. 8, line 7, for example),

and computing a filter response for at least one path between the pairs (cols. 7-8). Nagamitsu does not expressly disclose a specific data structure, for example, tree as claimed. Such feature is well-known in the art. In fact, Reed teaches method and

system for modeling wave propagation in tree data structure for ray tracing, such tree structure is called beamtree (Figs. 2, 14, col. 5, lines 8-63, for example) to improve memory storage and computation speed in ray tracing techniques.

This would motivate practitioner in the related art at the time of the invention was made to combine Reed teaching of tree data structure to store model data into ray tracing techniques as disclosed in Nagamitsu to improve computation and memory storage as taught in Reed in the Background of the Invention.

As per claim 30, Nagamitsu discloses sound source simulation between an audio source and a receiver location (Summary of the Invention).

As per claim 31, Reed teaches tree structure or beam tree structure for modeling traced ray (Figs. 2 and 14), and encoding for reverberation paths in sound simulation environment as disclosed in Nagamitsu.

As per claim 32, Reed teaches tracing adjacent cells or nodes via structure of beam tree in a spatial environment, which could include the claimed limitation for tracing adjacent cells.

As per claim 33, Nagamitsu discloses computing reverberation source paths between the plurality of sources (cols. 5 and 6), and Reed teaches tracing beam tree in ray tracing techniques (Fig. 2, 14, col. 5, lines 8-63, col. 7, lines 15-65, for example).

As per claim 34, Nagamitsu discloses such limitations in virtual sound simulation in spatial regions as claimed.

Response to Arguments

Applicant's arguments filed 04/26/2005 have been fully considered but they are not persuasive.

In response to applicants' argument that Nagamitsu does not disclose computing wave method with priority order as claimed, the examiner disagrees with. Nagamitsu discloses a wave computation method in a real time environment to improve sound quality and to give the listener an impression of the sound quality in the specific spaces (col. 3, lines 9-33, lines 43-55, for example). Nagamitsu requires convolving the impulse response and listener desire positions on the sound source data to generate the reproduced data. Since convolution is a linear operator having associative property, it can convolve impulse response components in a priority order to reproduce a sound wave in a specific location in real time as claimed.

In response to applicants' argument Nagamitsu does not compute a filter response based on constructed data structure, the examiner disagrees with.

Conclusion

1. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

1. US patent no. 5,784,467, issued to Asayama, Hiroshi, on July 1998

2. US patent no. 6,751,322, issued to Carlbom et al, on June 2004

2. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

3. Any inquiry concerning this communication or earlier communications from the examiner should be directed to examiner Thai Phan whose telephone number is 571-272-3783.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kamini Shah can be reached on 571-272-2279. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Mar. 01, 2006

Thai Phan

Thai Phan
Patent Examiner